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(NASA-CR-195256) GLOBAL BAROTROPIC
RESPONSE TO A TROPICAL FORCING
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GLOBAL BAROTROPIC RESPONSE TO A TROPICAL FORCING

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1. INTRODUCTION

Zonally varying flow has been used to initialize numerical models and has been shown to play an important role in strong localized responses both in extratropics and the tropics. In this study, a climatological 200 mb January mean is used as a steady basic state of a barotropical model which consists of shallow water equations and a mass source centered at $4^{\circ}\text{S}/120^{\circ}\text{E}$ to simulate convective heating over Indonesia region. In the experiment, tropical responses appear not only over the western Pacific, where the forcing is located, but also over the eastern Pacific where the response is related to the zonally varying basic state. The westward propagating equatorial Rossby waves excited by the forcing interact with

waves out of and into the tropics and the positive and negative phase of the Rossby waves result in blocking circulation over North America and tropical plumes over equatorial eastern Pacific, respectively.

2. MODEL RESULTS

The existence of equatorial westerlies over the eastern Pacific in the basic state allows the extratropical wavenumber, initiated over the tropical western Pacific, to propagate back into the tropics over the eastern Pacific (Fig. 1). However, penetration of the extratropical waves into the tropics is dependent on the phase of the forced equatorial Rossby waves (Fig. 2). As the cyclonic pair represented by westerlies on the equator moves into the eastern Pacific

Fig. 1. Perturbation meridional wind at day 6 of the model simulation. Contour interval is 0.005 m s^{-1} with southerlies solid and northerlies dashed. Zero contours are omitted. Area enclosed by heavy solid line is the forcing region.

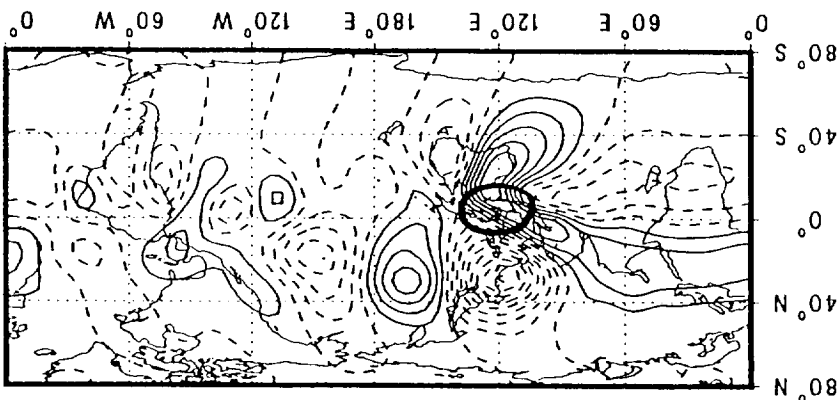
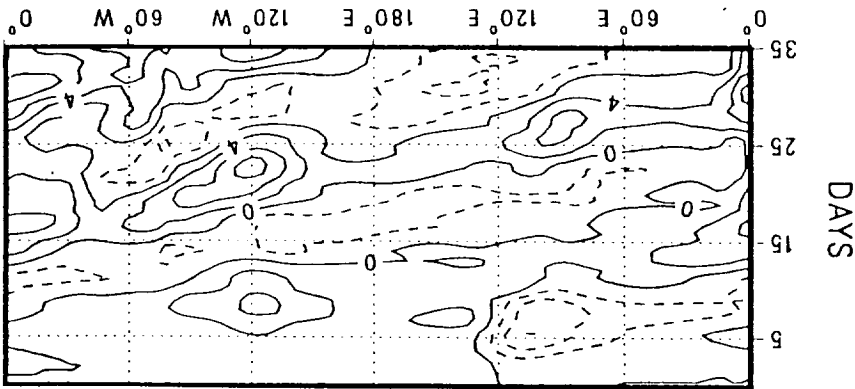


Fig. 2. Hovmöller diagram of perturbation zonal wind along the equator. Contour interval is 0.4 m s^{-1} with westerlies solid and easterlies dashed.



and Indian Ocean, these regions become favorable for the equatorward penetration of the extratropical waves, and the two waves together produce strong local tropical responses. As the anticyclonic pair represented by easterlies on the equator moves into these two regions, it pushes the wavertrain away into higher latitudes, producing only weak tropical response. Two snapshots of the circulation at a time when the cyclonic pair and the anticyclonic pair propagate into the eastern Pacific are shown in Fig. 3 and Fig. 4. In Fig. 3, the cyclonic circulation of the Rossby wave and the equatorward penetration of the extratropical waves work together to induce an equatorward bending of the subtropical jet, which resembles the frequently observed tropical plumes (McGuirk et al, 1987). In Fig. 4, the anticyclonic circulation of the Rossby wave prevents the penetration of the extratropical waves into the tropics and results in a strong ridge and a deep trough over North America, this pattern resembles blocking during the northern hemisphere

Fig. 3. Perturbation stream function at day 22 of the model simulation. Contour interval is $4 \times 10^5 \text{ m}^2 \text{ s}^{-1}$.

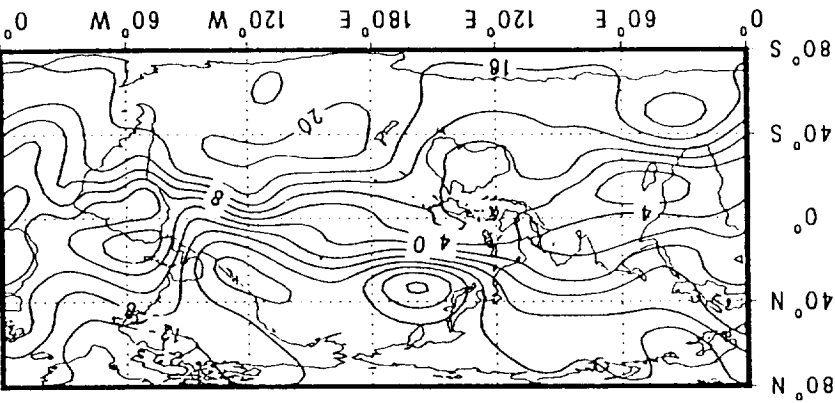
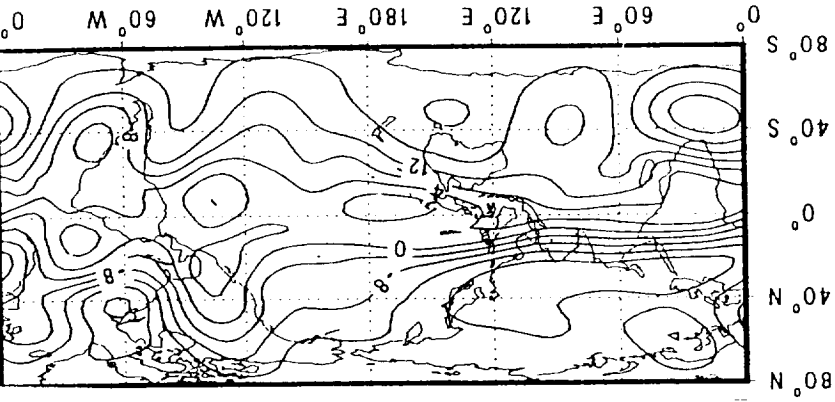


Fig. 4. Same as Fig. 3, except for day 28.



3. REFERENCE

- McGuirk, J. P., A. H. Thompson and N. R. Smith, 1987: Moisture Bursts over the Tropical Pacific Ocean. *Mon. Wea. Rev.*, **115**, 787-798.

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winter. The circulations in Fig. 3 and Fig. 4 oscillate with a period of 15 days during the course of the model simulation (see Fig. 2). Basically, a wavenumber one (Rossby pattern) is produced with smaller scale waves superimposed over the eastern Pacific and South America. The decreasing in the scale and phase speed of the equatorial Rossby waves may be due to the strong negative stretch of zonal wind in the basic state.